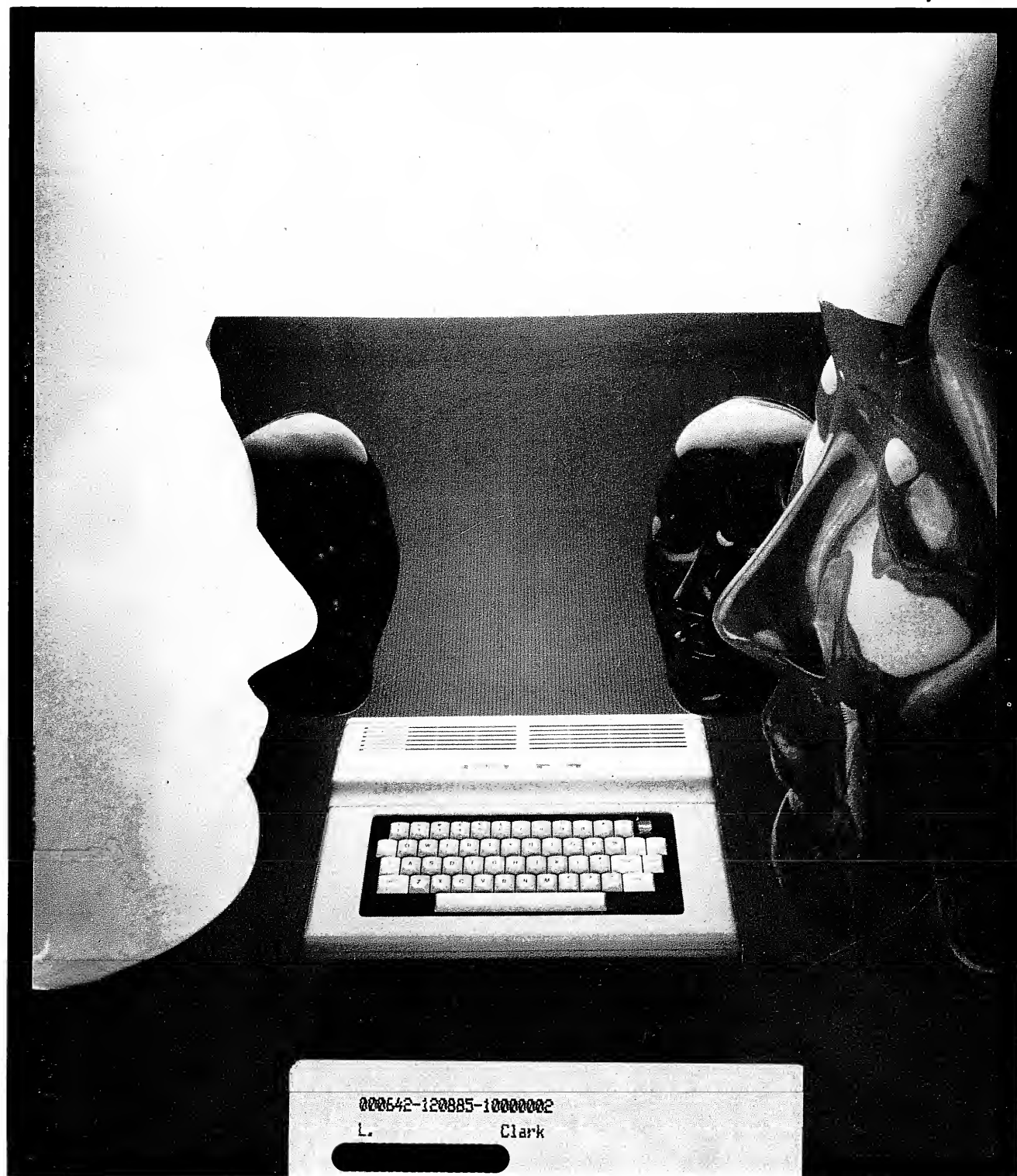


UNDERCOLOR

Vol. 1 No. 1

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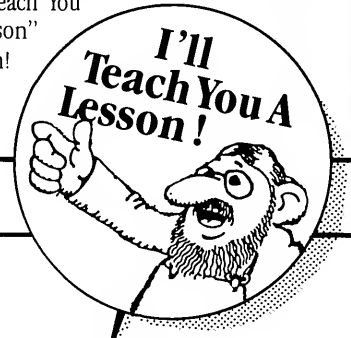
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Table of Contents

- **Defuser** page 2
By Terry Kepner *All you could ask for.*

- **A Real-Time Talking Clock** page 5
By Dennis Kitz *The first of several parts.*

- **Box 6809** page 6
Comments from our readers.

- **Memory Test** page 13
By Stephen P. Allen *Do you really have 64K?*

- **Off Color: Who's Fibonacci?** . . page 16
By Mark Haverstock *A light-hearted look at numbers*

- **News and Gossip** page 18
Carefully prepared, delicately worded, infinitely interesting.

- **Win Bill Barden!** . . page 22
By William Barden, Jr. *Bill poses a fun problem.*

- **Bulletin Board Listings** page 23

- **Reviews** page 24

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Who's Who

Editor

Debra A. Marshall

Technical

Dennis Bathory Kitz

Contributing Photographer

Charley Freiberg

Production Manager

Clare McCarthy

Paste-Up

Janet Patterson

God-Send

Joanne!!

Advertising:

Judy Knapp
(802)485-6139

Advertising:

Spencer Knowlton
(207)785-4151

Office

(802)485-6440

Editorial Office

(207)785-5148

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I want to interface my printer, an Epson MX-80 F/T with GrafraxPlus, to my late model TRS-80 64K Color Computer II, at the computer's serial I/O port. I also want to maintain this printer in-line with my 32K Model I (no expansion interface).

I have written to five different suppliers of serial-to-parallel printer connectors and have received as many different offers for interfacing the printer, but none would assure me that the printer can be effectively interchanged between the two computers.

The Epson printer is modified with the Epson TRS-80 interface board (no. 8120) and the Epson Interface Cable Connector (no. 8221, #825), connected to the Model I at the left rear of the keyboard. The new 64K Color Computer is interfaced to a Color Computer II disk drive zero. I also have a R/S Parallel LPII Interface (no. 1416) with cable.

I hope you can suggest a means to use both systems with the one printer.

Julian Jatyna
46 Old South Rd.
South Berwick, ME 03908

The standard Epson printer uses a parallel port, so all you need to use it on your Color Computer is a serial-to-parallel converter. However, since you're not using an Expansion Interface with your Model I (which normally contains the Model I's parallel port), you're using the Epson 50-pin-to-parallel interface board. If the interface board is plugged into the Epson, inside the case, you won't be able to use the Epson with your Color Computer unless you remove the board and use the normal parallel Epson printer port.

If you have an Expansion Interface with a parallel printer port, you could just get some type of hardware switch to select which computer was plugged into your printer, with all three devices plugged into the switch. In one position the switch connects computer A with printer, in the other position computer B is connected. You can't just plug both computers to the same printer cable without risking damage to all three devices; only one printer at a time can be electrically connected to a computer, and vice versa.

So, if the Epson/Model I interface board is outside the Epson, you can put the hardware switch between the interface board and the printer, letting you switch between the two computers (assuming you have a serial-to-parallel interface on the Color Computer).

If the interface board is inside the Epson, or the Epson doesn't have a parallel port, then you can't use the Epson with the Color Computer.

I have a 32K Extended Basic Color Computer. Could you tell me what hardware is necessary to use the computer to make contact with my office mainframe? Are there statistical packages available which are comparable to SPSS, BMD, or similar packages?

Bonnie MacLean
280 E. Western Reserve Rd.
Poland, OH 44514

You need two things: a modem with a Color Computer RS-232 cable, to connect the Color Computer to your telephone; and some type of telecommunications program for the Color Computer, so what you type goes to the phone lines, and what the mainframe sends is displayed on your monitor. For this to work, your office mainframe must have an auto-answer modem, so it can answer the phone when you call from home, plus the necessary software for the mainframe to accept instructions from the phone line.

Since I don't know the features of SPSS and BMD, I can't make any suggestions as to the acceptability of Color Computer statistical packages. Can someone else help?

Reading the November, 1983 DEFUSER column in The Color Computer Magazine, I noticed a letter asking about 220 volt 50-cycle power and the Color Computer. I hope my experience can help. I'm stationed with the USAF in Europe and have been using my 16K revision D Color Computer, Line Printer VII, Radio Shack cassette, and Radio Shack disk drive for approximately one year here. In all this time my system has been running on 120 volt 50-cycles stepped down from 220 volt 50-cycles. I have experienced no problems using a standard step-down transformer. The 50 cycles has not changed anything noticeable. I have used my Color Computer for eight to ten hours at a time with no problems. I did have to make one very simple adjustment on the disk drive: setting the drive to 50Hz operation. The Radio Shack disk drive comes with 50/60-cycle hash marks on the drive wheel; after removing the cover, adjust the motor potentiometer until the 50-cycle marks appear to stand still when viewed under a fluorescent lamp (this can be done without voiding your Radio Shack warranty). The adjustment potentiometer is located next to the drive wheel. Without this adjustment, the drive won't recognize the DSKINIO command.

In some situations a change from 60-cycle to 50-cycle power can cause a heating problem for the Color Computer power transformer. This is normal and over a long period of time could cause power supply problems. I haven't experienced any problems, but my computer system is located in a fairly stable temperature environment. If the area for the computer were very warm in the summer, I would recommend taking along a cooling fan.

One last note: I have just purchased the new Radio Shack 64K Color Computer 2, the Color Computer 2 disk drive, and the Radio Shack version of OS-9. I have everything except the disk drive, and again have no power problems. Hope this information has been of help.

T.A. Ward
Box 1211
APO NY 09453

Thanks for giving us an account of your experiences overseas; my readers will appreciate it.

I read an article about an Apple computer interfaced to a laser disk player. Can the Color Computer

(64K) be interfaced to a laser disk player? If so, can I use my computer to write a machine code routine to control the laser disk? Also, do the companies that sell 64K programs use the full 64K?

Wayne Tracer
Star Rt. Box 1201
Chiloquin, OR 97624

The Apple/laser disk combination requires a special hardware board plugged into the Apple mother board, with a cable running to the laser disk. This board translates instructions from the 6502 CPU into commands that can be executed by the laser disk controller. To the best of my knowledge, no one has as yet developed a hardware interface for the Color Computer to use a laser disk, although it shouldn't be all that hard since the Color Computer ROMpak port makes all the control and data lines available.

We'll probably see this hardware configuration on the market soon, especially since the new laser disk memory units are moving out of the laboratory and into the market.

All the companies that make 64K programs require that your computer have 64K RAM before the programs will work. Most of them use the entire 64K (less system RAM requirements) for their operation. Programs that specify 32/64K usually use only 32K, but may have 64K options that only run when the extra memory is available; these programs automatically test for 64K memory.

I won a 64K Color Computer, and I recently purchased a Modem II and the Deluxe RS-232 Communications ROMpak. I read the Modem II technical manual to discover if it is capable of auto-dialing with tones or pulse. Unfortunately, the Deluxe ROMpak programs the modem for fast-pulse rotary dialing only. This is OK for local calls, but on MCI and Sprint I'm unable to use the modem's auto-dial function; these services require tones. Is there any way to get the tone option programmed into the modem instead of the pulse? And do you know of any BBSs in my area?

Michael S. Parker
7147 Old King Rd. S. #22
Jacksonville, FL 32217

Sorry, but the only way I know of to change the modem to tone dialing is to reprogram the communications ROMpak to use tone instead of pulse, which would require disassembling the ROM, finding the offending code, removing the ROMpak ROM, and replacing it with a new one containing the fix; none of which is easy.

Does anyone have a possible solution, or know where M.P. can get a "fixed" Communications ROM?

Here's a short list of Color Computer BBSs in Florida: Colorama of St. Petersburg, FL, 813-345-8100; Colorama of Dunedin, FL, 813-733-2415; Ft. Lauderdale, FL, 305-525-1192; Lantana, FL, 305-533-0333; and Hialeah, FL, 305-681-8490.

I recently bought a 16K to 32K upgrade kit. The advertisement says the kit has easy instructions, but I found them hard to follow. I also had to buy extra tools to install the kit.

Please tell me how to get the memory chips off the board.

Marc Jenkins
713 Vernon Rd.
Philadelphia, PA 19119

Removing memory chips from IC sockets is simple in concept, but requires a bit of dexterity. Use a small screwdriver, or a small nail-file, to gently pry up each chip. Or you can use a commercial IC puller, which looks like an oversized pair of tweezers with the tips bent towards each other. The ends fit under the chip, and you pull the chip straight out of the socket.

When using a screwdriver to pry up a chip, be careful not to bend any of the IC's legs. If you do, carefully straighten the bent leg. If you break it off, you'll have to replace the chip. Also, memory chips are static sensitive, so always handle them by their bodies, not the legs, and set them down on black foam or a sheet of aluminum foil. Good luck.

I'm interested in exploring the world of BBS. I own a 64K Extended Color Basic computer. At the moment I don't have a Color Computer modem (it's second on my wish list, after disk drive zero). I do have, however, an IBM 8775 terminal and radial-Vac modem (Model VA2450) that I use, on loan from my employer, to tie into a mainframe at work. Are there any BBSs I can access with this terminal? If so, are there any BBSs in the south New Jersey area?

My next question is: can this modem be used with my Color Computer? If so, what type of cables or adapters would I need?

Samuel Murphy, Jr.
9 Larchmont Dr.
Burlington, NJ 08016

I don't have access to either piece of equipment, so I can only answer in general terms: unless the IBM terminal uses special protocols, you should be able to use it with any BBS. Normal BBS communications use 300 baud, seven bit words, one stop bit, even parity, and XON/XOFF protocol. If you can't set these parameters on your IBM terminal, then it can't be used for normal BBS work. If the modem is a standard RS-232 input, 300 or 1200 baud unit, then you should be able to use it with your Color Computer using the Radio Shack Color Computer RS-232 cable (which is designed to plug into an RS-232 modem). If the modem doesn't have a DB-25 RS-232 connector on it, you'll have to come up with your own Color Computer-to-modem cable layout.

Has anyone successfully used a Radial-Vac modem with the Color Computer?

Here are two New Jersey BBS numbers (both are 300 baud numbers): Colorama of Highland Park, 201-572-0617; and Meadowland CoConet, 201-773-8265. (end)

Here's a few notes from readers:

Ideas:

- *How do you program an EPROM to start on Reset like Basic?
- *A weather station using A-0, temperature sensors, wind speed, etc.
- *How to program EPROMs using DEFT Systems Pascal
- *How to get OS-9 and Basic 09 to talk to the outside world
- *How to write device descriptors for OS-9

—Frank Dupont, Detroit, MI

Comments:

*At first I thought you [Dennis] were quitting your job with *TCCM*. That didn't seem right. Then I thought perhaps you were fired, but that didn't seem right either . . . —Dave Shewchun

*Custom Color *has* to continue, for many good things to sink my teeth in are still under blankets . . . —David Nicol

*Nice to hear that a new CoCo publication is starting up . . . —Allan Ashton

*[Referring to this publication] Please accept this letter as my vote in favor of such a project!—Jon Morse

*[Referring to Custom Color] I have always enjoyed your column (even though I usually didn't understand it) . . . —Jock Kraft

* . . . you've given us our magazine back—only better!—Dennis Peterson

Info:

*I own one of the last "battleship gray" CoCo's—one of the group with the "A" on the end of the serial number. It started life as a 16K Standard Color Basic machine, but is now adjusting to its new career with Extended Basic. I eventually hope to have 64K, at least one disk drive, and perhaps a switchable color monitor driver. I say switchable because I would like to keep the TV interface around—it's convenient to have. I also need a printer.

You've probably got the idea I'm a fan of the CoCo, and so I am. However, I do have a few gripes with the machine. The new keyboard took care of one problem, but that display . . . If only Tandy hadn't slavishly devoted themselves to Motorola IC's. The chips are fine for hi-res, and I don't even mind the "checkerboard" lowercase, but 32 columns is just a bit limiting. Oh, well, I "grew up" using an Apple II+ with only 40 columns and not even an attempt at lowercase, so I can adjust. Besides, trying to fit useful information into a 32 x 16 screen nicely is a challenge, and I enjoy a good challenge.

Speaking of Apple, I don't know whether you're familiar with those machines, but a CoCo with 64K, disk, and EDTASM+ ROMpak is comparable to or maybe even a bit more powerful than an Apple II+ was. Even the assembly languages are similar. The major differences are as follows:

Color Computer

- 32 column display
- up to 4 DD disk drives
- ROM monitor/ assembler available
- TV video output
- 256 x 192 hi-res graphics, 9 distinct colors
- 64 x 32 lo-res graphics, 9 distinct colors, free mixing of text
- built-in RS-232 port, 1 expansion (ROM) slot
- limited but expanding software base

Apple II+

- 40 column display
- up to 4 SD disk drives
- ROM monitor built in, assembler available
- monitor video output
- 280 x 192 hi-res graphics, 6 distinct colors
- 40 x 48 lo-res graphics, 15 distinct colors, limited text
- 8 expansion slots
- very broad software base

The Apple has a slight edge in the video department, but each machine has its own advantages in this area. Overall, the two computers are roughly identical in power. And, of course, the price difference is rather profound.

Certain people have tried to compare the CoCo to the new IBM PC, but I think that IBM is just a little out of the CoCo's league in terms of software availability and ease of expandability—David M. Botkin

A Real-Time Talking Clock

Part I

A real-time clock with voice synthesis!

What would you like? A real-time clock? A voice synthesizer? Info on using joysticks? Software without added hardware? A couple of hardware projects to dig into? Okay, get ready: I've got a something-for-everyone series beginning this month that includes two ways of producing voice from the Color Computer and two ways of adding a real-time clock. Depending on how you fold them together, you can have Basic programs that speak or a clock that talks.

This month I'll be describing how to do voice synthesis — actually, voice "recording" — in software, using your joystick input and cassette output ports. In the process, you will learn how the joystick input works, what sampling and timing mean, how the sound output works, and how you can force the high-speed POKE to work in RAM.

After you've had a chance to play with the vocal input/output, I'll create a purely software real-time clock. Since real time anything has to be totally independent of the vagaries of software, you'll learn about interrupts and video synchronization.

In the second part of this series I'll discuss interfacing and using the General Instrument vocal tract synthesizer (sold inexpensively by Radio Shack), and feeding it through the cartridge SND input. That will open the door to combining the vocal hardware with the interrupt-based real-time clock to create a talking timekeeper.

Finally, part three will offer an allophone (speech sound) vocal tract synthesizer that will give you an unlimited vocabulary. I'll provide it with inflection, too, and throw in one more twist to the plot — a battery-powered real-time clock. That will inevitably lead to a rewarding combination: a talking clock that keeps time even when the computer is off. It, too, will be interrupt-driven and completely transparent to other computer operations.

DIGITAL RECORDING. The basic principles of digital recording were explained in my article on Color Quaver (TCCM, November and December, 1983). Here's a review.

Sound is transmitted by variations in air pressure. Pressure variations are transformed by microphones into proportional electrical voltages. In analog recording (such as a phonograph record) the voltages are stored as wiggles in a record groove; in tape recording, the voltages be-

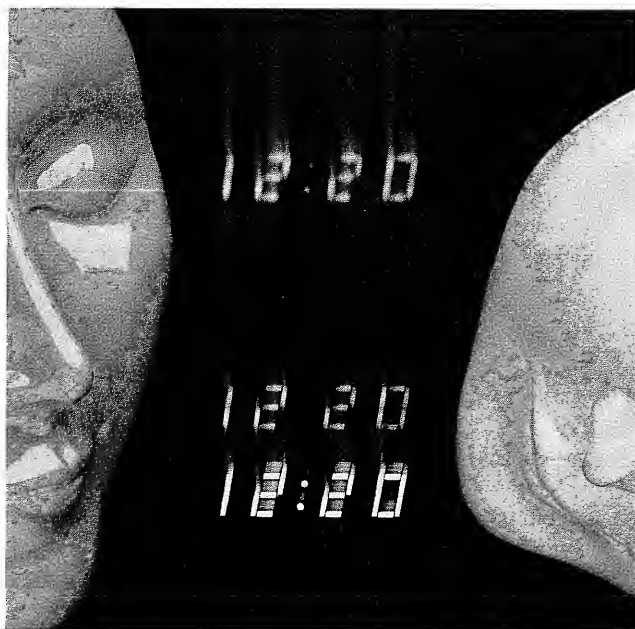
come variations in magnetic intensity. By reversing the process and forcing voltages through a loudspeaker, air pressure variations can be reproduced; sound results. At all of its stages, analog recording "looks" like the original sound in some respect.

Digital recording also transforms the air pressure changes into electrical variations, at least to start. From that point, though, the process differs dramatically. The electrical variations are measured at regular intervals, and the voltage that has been measured is stored in computer memory, or on disk or tape. To play the sound, the stored numbers are converted back to voltages at exactly the

same rate that they were originally measured.

The process of measuring the changes in incoming voltage is called sampling, and the frequency of this process is called the sampling rate. The accuracy of the measurement is called its resolution. *Sampling rate* is expressed in kilohertz (thousands of cycles per second, abbreviated KHz), and *resolution* is provided by the number of bits used to sample and store the incoming voltage. The sampling rate affects the fidelity of the sound (faster sampling means a wider frequency range), and the resolution affects the level of sound intensity and noise (higher resolution means wider dynamic range and a better signal-to-noise ratio).

In the demonstration I've got for you, the sampling rate is about 3.6 KHz (7.2 KHz on a 64K computer using the



high-speed RAM mode), and the resolution is six bits. The resulting frequency range ends at 1.8 KHz (3.6 KHz on a high-speed 64K computer), and the signal-to-noise ratio is a poor but quite intelligible 36 dB. High fidelity it ain't. Again, you'll find details in the articles on Color Quaver.

The Color Computer has all the means to record and play back voice or music. You won't get much of it — 4.5 seconds is as long as it will last in 16K of memory — but it will start you on adding voice to your Basic programs or doing experiments with digital sound recording.

THE JOYSTICK. The key to digital sampling is joystick input. Unlike simple Atari-style joysticks, which are made up of just four switches, Color Computer joysticks are variable resistors like stereo volume controls. A voltage (actually +5 volts) is placed on one side of the resistor, and ground is hooked to the other side. The variable resistor's "wiper" sweeps from the ground side to the +5 volt side as you move the joystick, producing a variable voltage at the wiper contact. If the distance from ground to the wiper is labeled A and the distance from +5 volts to the wiper is called B, then the voltage at the wiper is $5 \cdot (A / (A + B))$.

The Basic command `PRINT JOYSTK(0)` causes the computer to sample the voltage at the joystick wiper. The number displayed is 0 to 63, representing a range from $\frac{1}{64}$ ths of five volts (zero volts) to $\frac{63}{64}$ ths of five volts (4.92 volts). Try it; enter these lines:

```
10 CLS : A$="#.## VOLTS"
20 A=JOYSTK(0)
30 PRINT@269,USINGA$;5*A/64;
40 GOTO20
```

As you move the joystick, the voltage being sampled (within $\frac{1}{2}$ bit, or $\frac{1}{4_{28}}$ volt) will be displayed.

The significant question is how the joysticks work. The voltage values don't just jump into the computer. And if you're looking for a sophisticated analog-to-digital converter chip, you won't find it.

The answer lies in Radio Shack's desire for a low-cost solution, and their cleverness in finding it. Converting a number to a voltage turns out to be an easier task than going the other way 'round. Converting a number to a proportional voltage goes this way: The binary value is fed through a group of resistors; each resistor contributes twice the previous amount of voltage (each bit to the right is twice the value of its neighbor to the left). Binary arithmetic prevails (I'm rushing here), and the resulting voltage ends up proportional to the original binary number. Figure 1 is the schematic of the digital-to-analog output stage of the Color Computer (the Color Computer 2 uses a custom integrated circuit for this).

If you can output a known voltage cheaply and easily, then you can measure any unknown voltage by comparing the two until you get a match. The known voltage feeds into one side of a commonplace electronic device

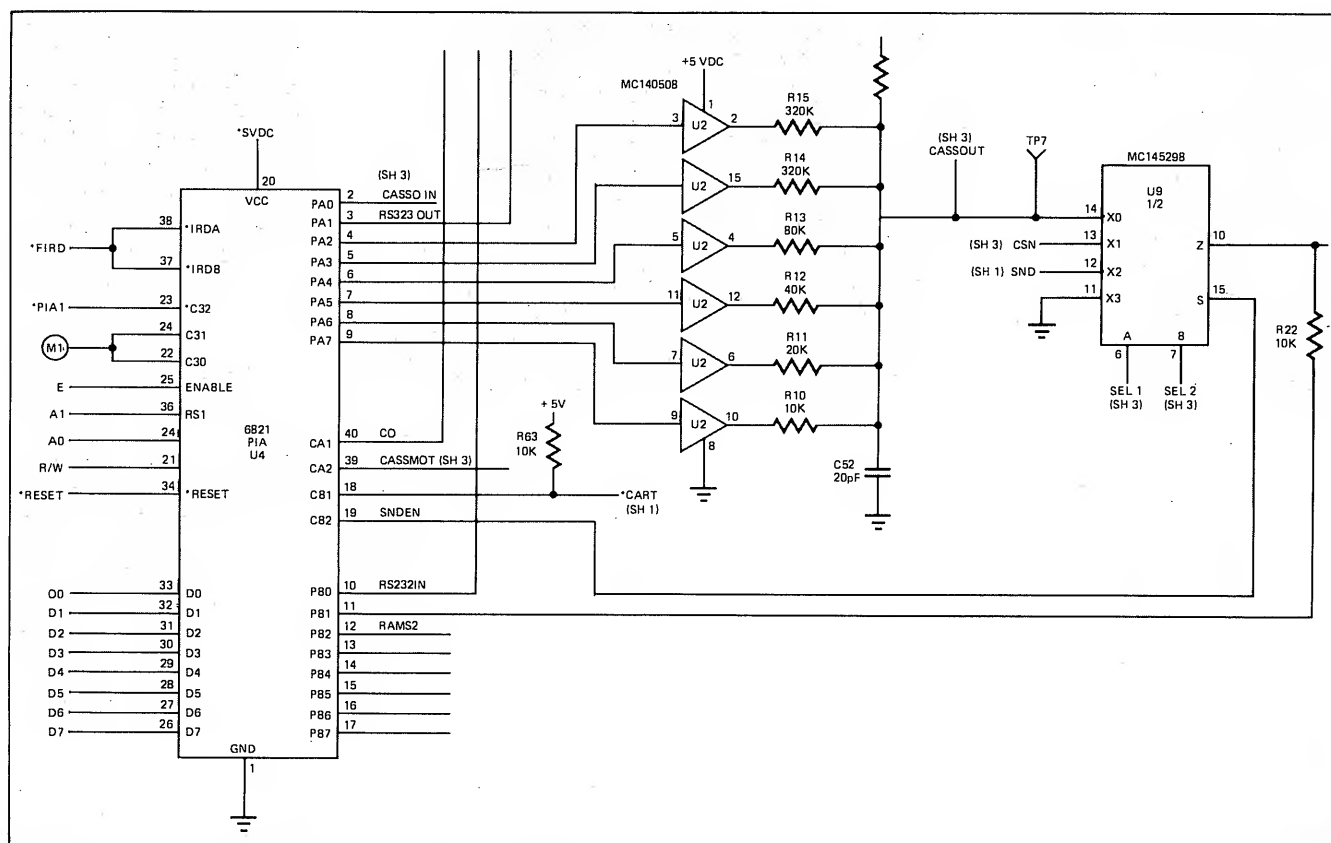


Figure 1. Digital-to-analog output stage. Reprinted with permission from the *TRS-80™ Color Computer Technical Reference Manual*, page 66.

UnderColor • 7

DIGITAL RECORDER. So how does knowing how the joystick input works help you make a digital recording of your voice? Remember that the first stage of digital recording is the transformation of air pressure variations into proportional voltages. If the joystick input can measure joystick voltages, then shouldn't it follow that it can

measure voltages from, say, a cassette player or microphone amplifier? Yes, it can. Basic can't do it because it's too slow. But machine code — at 3,600 samples per second — can pull in a reasonable representation of a voice.

Once you've got the voice stored as a series of numbers, reproducing it is easy. You swing through memory, taking

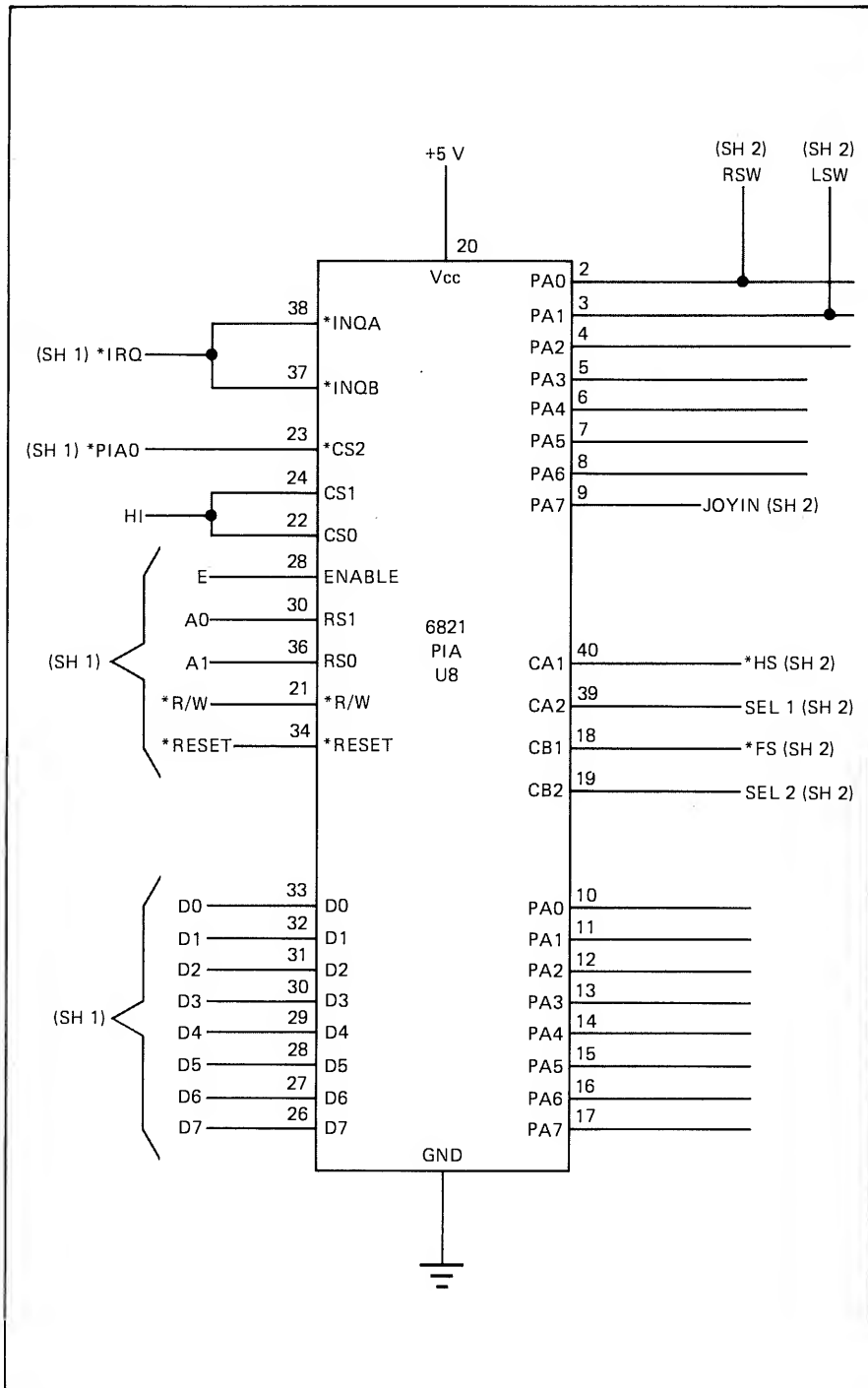


Figure 3. Joystick input PIA, showing the bit assignments of various peripherals; interrupt handling is also visible. Reprinted with permission from the *TRS-80™ Color Computer Technical Reference Manual*, page 68.

PROGRAM LISTING 1

Basic emulation of a joystick input routine.

16K Extended Color Basic

```

1 CLS
2 X=&HFF00      '* PORT VALUE
3 DAC = &HFF20  '* D/A CONV.
4 ADC = &HFF00  '* COMPARATOR
5 POKE &HFF01,&H34 '* CTRL. INFO
6 POKE &HFF03,&H37 '* CTRL. INFO
7 A = &H80      '* B 10000000
8 T1 = 6        '* ITERATIONS
9 T2 = &H80     '* B 10000000
10 POKE DAC,A   '* SEND VALUE
11 B = PEEK(ADC) '* BYTE BIT 7
12 B = B AND &H80 '* TEST BIT 7
13 IF B = 0 THEN 17 '* IF FLIPPED
14 T2 = T2/2    '* ELSE LESS
15 A = A + T2   '* ADD VALUE
16 GOTO 19     '* GO TO NEXT
17 T2 = T2/2    '* IT IS MORE
18 A = A - T2   '* ELSE MORE
19 T1 = T1 - 1  '* SUB. VALUE
20 IF T1>0 THEN 10 '* DONE YET?
21 PRINT@0,"JOY ="; '* A MESSAGE
22 PRINTINT(A/4)  '* A JOYSTICK
23 GOTO 7       '* & DO AGAIN
    
```

PROGRAM LISTING 2

Machine code version of a joystick input routine, using a binary search.

```

00270 LDA    #$34
00280 STA    $FF01
00290 LDA    #$37
00300 STA    $FF03
00310 *
00320 NEXTIN LDA    #$06
00330 STA    <TEMP1
00340 LDA    #$80
00350 STA    <TEMP2
00360 *
00370 AGAIN STA    DAC
00380 ROL     ADC
00390 BCC    BIGGER
00400 LESSER LSR    <TEMP2
00410 ADDA   <TEMP2
00420 BRA    JUMP
00430 BIGGER LSR    <TEMP2
00440 SUBA   <TEMP2
00450 BRA    JUMP
00460 JUMP   DEC    <TEMP1
00470 BNE    AGAIN
00480 STA    ,X+
00490 *
    
```

each byte and feeding it to the digital-to-analog converter. The reproduced sound appears at the output. The only thing you need to keep in mind is that homing in on the sound sample takes longer than reproducing the sound by outputting a sample value...so you've got to add a little delay to keep the input and output rates matched.

Look at Listing 3, a complete record-reproduce program for the Color Computer. The heart of the joystick input program you've already seen is found in Lines 240 – 520. The output routine is in 620 – 690. You can see that Lines 650 – 670 add the delay needed to keep input and output matched.

There are only a few other items to note. First of all, direct addressing is used to speed the program along (Lines 220 – 230). Next, interrupts are turned off to keep the sampling rate rock solid (Line 200). And finally, the "fast RAM" mode is used during the input and output sections (Line 210).

What is *fast RAM*? What are the mysterious high-speed POKEs all about? Here's the deal. The innards of your Color Computer are created from off-the-shelf components suited to many purposes. One of these is called the SAM (Synchronous Address Multiplexer). The SAM can support several computer *configurations* — that is, several combinations of types and sizes of RAM. The Color Computer uses several memory sizes (4K, 16K, 32K, 64K) but supports only one RAM type: dynamic.

Dynamic memory, through creative development and lots of luck, is low in power required and physically compact. Best of all, it is inexpensive. On the other hand, its special construction requires a continual *refresh* of its contents. This refresh is accomplished by reading 128 sequential memory locations at least every microsecond. The refresh complicates computer design because it has to be squeezed in between sequential instructions carried out by the central processing unit (CPU).

Designers at Motorola solved the problem by developing a combination of three sophisticated parts: the 6809 CPU itself, the SAM, and the 6847 video display generator. These work together to execute computer instructions, refresh the dynamic memory, and provide a video display.

Imagine the master clock of the Color Computer as a sequence of regular on-off pulses. During pulses 1, 3, 5, 7, 9 and so forth, the CPU executes its instructions from memory. During even-numbered pulses 2, 4, 6, 8 and so on, the memory is freed from the CPU to create the video display or to carry out the dynamic memory refresh. Since the video display generator also uses sequential addresses when it draws the screen, any video display has the effect of refreshing the memory.

When you turn your Color Computer on, it creates those alternating pulses — first one for the CPU, then one for the video or refresh. It provides the pulses to all of memory. When you POKE 65495,0 (the usual so-called "high-speed" mode), you keep the refresh and video to the dynamic memory, but drop the extra pulse out when the computer uses the Basic ROM. Basic ROM is static and needs no refresh.

PROGRAM LISTING 3

Continuous record/reproduce program.

32K Extended Color Basic

```

FF20      00100 DAC      EQU      $FF20
FF00      00110 ADC      EQU      $FF00
FFD9      00120 FAST     EQU      $FFD9
FFD8      00130 SLOW     EQU      $FFD8
4000      00140 MEMBOT   EQU      $4000
8000      00150 MEMTOP   EQU      $8000
          00160 *
3F00      00170          ORG      $3F00
          3F      00180          SETDP $3F
          00190 *
3F00 1A 50 . 00200 START  ORCC     #$50
3F02 B7 FFD9 00210          STA     FAST
3F05 86 3F    00220          LDA     #$3F
3F07 1F 8B    00230          TFR     A,DP
          00240 *
3F09 8E 4000 00250          LDX     #MEMBOT
          00260 *
3F0C 86 34    00270          LDA     #$34
3F0E B7 FFD1 00280          STA     $FF01
3F11 86 37    00290          LDA     #$37
3F13 B7 FFD3 00300          STA     $FF03
          00310 *
3F16 86 06    00320 NEXTIN LDA     #$06
3F18 97 9B    00330          STA     <TEMP1
3F1A 86 80    00340          LDA     #$80
3F1C 97 9C    00350          STA     <TEMP2
          00360 *
3F1E B7 FF20 00370 AGAIN  STA     DAC
3F21 79 FF00 00380          ROL     ADC
3F24 24 06    00390          BCC     BIGGER
3F26 04 9C    00400 LESSER LSR     <TEMP2
3F28 9B 9C    00410          ADDA   <TEMP2
3F2A 20 06    00420          BRA     JUMP
3F2C 04 9C    00430 BIGGER  LSR     <TEMP2
3F2E 90 9C    00440          SUBA   <TEMP2
3F30 20 00    00450          BRA     JUMP
3F32 0A 9B    00460 JUMP    DEC     <TEMP1
3F34 26 E8    00470          BNE     AGAIN
3F36 A7 80    00480          STA     ,X+
          00490 *
3F38 8C 8000 00500          CMPX   #MEMTOP
3F3B 26 D9    00510          BNE     NEXTIN
          00520 *
3F3D 4F      00530          CLRA
3F3E 1F 8B    00540          TFR     A,DP
3F40 B7 FFD8 00550          STA     SLOW
3F43 39      00560          RTS
          00570 *
3F80      00580          ORG      $3F80
          00590 *
3F80 1A 50    00600 PLAYBK ORCC     #$50
3F82 B7 FFD9 00610          STA     FAST
3F85 8E 4000 00620          LDX     #MEMBOT
3F88 A6 80    00630 SPEAK  LDA     ,X+
3F8A B7 FF20 00640          STA     DAC
3F8D C6 2C    00650          LDB     #$2C
3F8F 5A      00660 LOOP    DECB
3F90 26 FD    00670          BNE     LOOP
3F92 8C 8000 00680          CMPX   #MEMTOP
3F95 26 F1    00690          BNE     SPEAK
3F97 B7 FFD8 00700          STA     SLOW
3F9A 39      00710          RTS
          00720 *
3F9B      00730 TEMP1  RMB     1
3F9C      00740 TEMP2  RMB     1
          00750 *
          00760
00000 TOTAL ERRORS
          00000
          8000 MEMTOP
          3F16 NEXTIN
          3F80 PLAYBK
          3F80 SLOW
          3F88 SPEAK
          3F00 START
          3F9B TEMP1
          3F9C TEMP2

```

The "super high speed" mode is POKE 65497,0. If you try it, though, your video display will go into a frenzy, and you might lose your programs. That's because this POKE tells the SAM to bother with neither refresh nor video, but rather to consider the computer a machine with static RAM and no display output. No refresh, no video.

In this mode you might lose your programs because the refresh cycle is missing and the memory gradually "forgets" its contents. The mode conditions are summarized in Table 1.

But why does the super high speed work for program Listing 3? In this case, sequential memory is being filled with voice information, and then the voice information is played back. At this program's speed, the very act of filling and reading back the sequential memory acts as a memory refresh! The contents remain intact, undisturbed... though the video display is useless.

Once you've saved the source program in Listing 3 (w VOICE), you can assemble it to memory (A/M/AO), quit the editor/assembler (q), and protect Basic memory (CLEAR 200,&H3F00). To use it, you'll need a joystick cable adaptor (see Figure 4). Turn the volume up on your television or monitor, pop a voice or music cassette into the recorder, and run the following lines:

```
10 EXEC &H3F00
20 EXEC &H3F80
30 GOTO 10
```

The screen will go haywire, but the computer will record and play back the sound every two seconds. If you want to see the actual sound displayed as a sound wave, tap the Break key and enter and run Listing 4.

USING VOICE WITH BASIC. Since Basic programs have to run at normal speed to refresh the RAM, the voice you use with Basic won't have the quality you can hear at the higher speed. No matter; for some programs, any voice at all is better than none, so drop Lines 120, 130, 210, 550, 610 and 700 from Listing 3. You'll be able to store four seconds of sound in the 16K of memory above location \$3FFF.

DIGITAL PUNCH IN THE NOSE. Now I'll turn away from digital voice recording to explore the first of two techniques for keeping the time of day. Keeping the "real time" is tricky because computer time is relative to its own master clock. The Color Computer's master clock (running at 894,886 pulses per second) is meaningful in just one way — you know exactly how much time each processor instruction takes. That's it; there's no easy way a program can know, so to speak, when one second has passed. Something has to knock on its door, interrupt its reverie, and punch it in the nose. That digital punch is known as an *interrupt*.

The Color Computer was built with interrupts in mind. The cursor flashes to the rhythm of interrupts, the Sound command counts them out to learn when it's done, and the timer runs with them. Fancy games depend on their presence.

Using interrupts isn't difficult, though it does call for a slight change of perspective. When you think of a program, you probably think of it as a logical series of commands followed one at a time without distraction. Interrupts seem to defy this concept, forcing the program away from its appointed tasks to work on something else.

That scenario is basically correct. The surprise is that the program in progress seems to have amnesia — it never remembers that it has been distracted from its work, can never recall what has happened during those lost microseconds.

The ideal interrupt happens like this: a signal (say, one synchronized with the video display) appears on the CPU's interrupt-request (IRQ) connection. If the machine code program in progress (such as the Basic interpreter) has *enabled* the interrupt process, then this signal will be accepted as soon as the CPU is finished with its present instruction. The machine state (all the registers, program counter, and flags) gets stashed, and the program counter is given a new value. The new value in the program counter points to an "interrupt service routine."

The interrupt service routine takes care of whatever the programmer had in mind for that particular occurrence of the interrupt. When the interrupt service routine is finished, the original machine state (group of registers and flags) is restored and the main program continues exactly where it left off. A little time has mysteriously disappeared during the course of the main program.

A real-time clock is a perfect example of interrupt use.

VIDEO SYNCHRONIZATION. The Color Computer invites interrupt exploitation because both vertical and horizontal video signals can be used to generate interrupts. Television images require electrical pulses to cause each frame to begin at the top of the screen, and other pulses to cause each scanning line to begin at the left side of the screen. The signal to begin each frame is called vertical synchronization, and the signal to begin each line is called horizontal synchronization.

Vertical sync, which occurs 60 times every second, is an ideal candidate for interrupt use. After six pulses have occurred, then, $\frac{1}{10}$ second has passed; after 60 pulses, one full second has passed. By keeping strict track of the pulse count, you can have a real-time clock.

Look at Listing 5, beginning at Line 200. At each interrupt pulse, the CPU will be directed there. Register X points to the final character in the clock image stored in memory, in ASCII, which starts at 00:00:00.00. The final digit is the $\frac{1}{60}$ of a second counter. This value is incremented (Line 220), and checked to see if it has reached six. If it's less than six, the image is transferred to the screen by the exit routine beginning at Line 490. If the counter has reached six, it is reset to zero and the $\frac{1}{10}$ of a second counter is incremented. If it hasn't reached ten, the routine exits; otherwise, the one-second counter is incremented. And so on, up to a total count of 99:59:59.95.

The exit routine transfers ten characters of the image to the screen. The $\frac{1}{60}$ of a second digit is not displayed.

POKE ADDRESSES	MODE	CONDITION
65494	65496	00 NORMAL
65495	65496	01 FAST ROM
65494	65497	10 FAST RAM
65495	65497	11 ALL FAST

Table 1. Memory clock speed control conditions within the Synchronous Address Multiplexer (SAM).



PROGRAM LISTING 4

Short Basic routine to display the sound wave representation of the sound recorded by Listing 3.

32K Extended Color Basic

```
10 CLSO
20 FORX = &H4000 TO &H8000
30 SET (Y, PEEK(X)/8, 5)
40 Y=Y+1: IF Y>63 THEN CLSO: Y=0
50 NEXT
```

PROGRAM LISTING 5

Real-time clock using the internal interrupts which occur 60 times each second.

32K Extended Color Basic

```
3F00          00100      ORG      $3F00
              00110      *
3F00 1A 50    00120      INTOFF  ORCC  #50      * TURN INTERRUPTS OFF
3F02 8E 3F10 00130      LDX      #START  * POINT X TO SERVICE ROUTINE
3F05 BF 010D 00140      STX      $010D  * STORE ROUTINE TO IRQ VECTOR
3F08 86 37    00150      LDA      #37     * VALUE 00110111 FOR MASKING
3F0A B7 FF03 00160      STA      $FF03  * TURN ON VERTICAL SYNC
3F0D 1C EF    00170      ANDCC    #5EF   * TURN INTERRUPTS ON
3F0F 39       00180      RTS        * AND BACK TO BASIC "OK"
              00190      *
3F10 8E 3F77 00200      START  LDX      #IMAGE+10 * POINT X TO 1/10 SEC.
3F13 C6 30    00210      LDB      #30     * B BECOMES ASCII OFFSET
3F15 6C 84    00220      INC      ,X      * INCREMENT 1/10 SECONDS
3F17 A6 84    00230      LDA      ,X      * GET 1/10 SECONDS VALUE
3F19 81 36    00240      CMPA     #36     * IS 6/10 SECONDS COUNTED?
3F1B 2D 2C    00250      BLT      OUT     * IF NOT 6/10 SECONDS, OUT
3F1D 8D 40    00260      BSR      DEC1    * ELSE BAC UP 1 MEM. LOCATION
3F1F 81 3A    00270      CMPA     #33A    * IS IT 1 SECOND YET?
3F21 2D 26    00280      BLT      OUT     * IF NOT 1 SECOND, OUT
3F23 8D 41    00290      BSR      DEC2    * ELSE BACK UP 2 MEM. LOCNS.
3F25 81 3A    00300      CMPA     #33A    * IS IT 10 SECONDS YET?
3F27 2D 20    00310      BLT      OUT     * IF NOT 10 SECONDS, OUT
3F29 8D 34    00320      BSR      DEC1    * BACK UP 1 MEM. LOCATION
3F2B 81 36    00330      CMPA     #36     * IS IT 60 SECONDS YET?
3F2D 2D 1A    00340      BLT      OUT     * IF NOT 60 SECONDS, OUT
3F2F 8D 35    00350      BSR      DEC2    * ELSE BACK UP 2 MEM. LOCNS.
3F31 81 3A    00360      CMPA     #33A    * IS IT 10 MINUTES YET?
3F33 2D 14    00370      BLT      OUT     * IF NOT 10 MINUTES, OUT
3F35 8D 28    00380      BSR      DEC1    * ELSE BACK UP 1 MEM. LOCATION
3F37 81 36    00390      CMPA     #36     * IS IT 60 MINUTES YET?
3F39 2D 0E    00400      BLT      OUT     * IF NOT 60 MINUTES, OUT
3F3B 8D 29    00410      BSR      DEC2    * ELSE BACK UP 2 MEM. LOCNS.
3F3D 81 3A    00420      CMPA     #33A    * IS IT 10 HOURS YET?
3F3F 2D 08    00430      BLT      OUT     * IF NOT 10 HOURS, OUT
3F41 8D 1C    00440      BSR      DEC1    * ELSE BACK UP 1 MEM. LOCATION
3F43 81 3A    00450      CMPA     #33A    * IS IT 100 HOURS YET?
3F45 2D 02    00460      BLT      OUT     * IF NOT 100 HOURS, OUT
3F47 E7 84    00470      STB      ,X      * PLACE $30 (ASCII ZERO)
              00480      *
3F49 108E 0416 00490      OUT      LDY      #0416 * POINT TO RIGHT SCREEN
3F4D 8E 3F6D 00500      LDX      #IMAGE * POINT X TO CLOCK IMAGE
3F50 C6 0A    00510      LDB      #0A     * COUNT 10 SCREEN POSITIONS
3F52 A6 80    00520      LOOP    LDA      ,X+ * GET CHARACTER FROM CLOCK
3F54 A7 A0    00530      STA      ,Y+ * AND PLACE IT ON THE SCREEN
3F56 5A       00540      DECB     * DONE WITH IMAGE YET?
3F57 26 F9    00550      BNE      LOOP * IF NOT, THEN GET NEXT CHAR.
              00560      *
3F59 B6 FF02 00570      LDA      $FF02 * CLEAR VERT. SYNC LATCH
3F5C 7E 894C 00580      JMP      $894C * AND TO BASIC TO DO RTI
              00590      *
3F5F E7 84    00600      DEC1    STB      ,X * PLACE $30 (ASCII ZERO)
3F61 6C 82    00610      INC      ,X * BACK UP ONE MEM. LOCATION
3F63 A6 84    00620      LDA      ,X * GET VALUE FROM IMAGE
3F65 39       00630      RTS        * BACK TO MAIN PROGRAM
              00640      *
3F66 E7 84    00650      DEC2    STB      ,X * PLACE $30 (ASCII ZERO)
3F68 6C 83    00660      INC      ,--X * BACK UP TWO MEM. LOCATIONS
3F6A A6 84    00670      LDA      ,X * GET VALUE FROM IMAGE
3F6C 39       00680      RTS        * BACK TO MAIN PROGRAM
              00690      *
3F6D          00700      IMAGE  FCC      /00:00:00.00/
              30
              30
              3A
              30
              30
              3A
              30
              30
              2C
              30
              30
              00710      *
              00720      END      INTOFF
00000 TOTAL ERRORS
```

```
DEC1 3F5F
DEC2 3F66
IMAGE 3F6D
INTOFF 3F00
LOOP 3F52
OUT 3F49
START 3F10
```


The amazing thing about this 116-byte routine is that, as programs go, it is totally mundane. It's nothing more than increment, test, proceed, move memory, and exit. The only item to note is found at Line 570. The command JMP \$894C lets Basic complete its part of the interrupt service routine chain (cursor, timer, sound) before returning to the program in progress.

Save the source code (w CLOCK), assemble this program into memory (A/IM/AO), quit the editor/assembler (Q), protect memory (CLEAR 200,&H3F00) and execute the machine code program (EXEC &H3F00). The clock will appear in the top corner of the screen, in reverse-video characters.

This software clock will survive resets and CLOADs (not necessarily CLOADMs), and will run under most program conditions. Naturally, if you have a 32/64K machine, you'll want to move it up in memory.

INTERRUPT THEORY. I passed by that interrupt theory pretty quickly to give you a chance to see it perform. There are some important things to understand before you put interrupts to work for yourself.

First of all, since interrupts come through at a regular pace, you've got to make sure you keep ahead of that pace. If you don't, you will not get back to the main course of your program properly.

Rule Number 1 is: make your interrupt routines short and efficient. When using the relatively laggard 60-per-second pulse of the vertical sync, that isn't much of a problem, because $\frac{1}{60}$ th of a second is 16,667 microseconds, or 14,915 Color Computer master clock pulses. The clock interrupt routine is lengthiest at the change back to 00 hours. Including the machine state saving at the interrupt itself, this requires 303 master pulses plus some more for Basic's timer, cursor and sound. The shortest execution for just a $\frac{1}{60}$ second count is only 35 master clock

pulses. Overall, the clock routine's time is minuscule with respect to the 14,915 master pulses available.

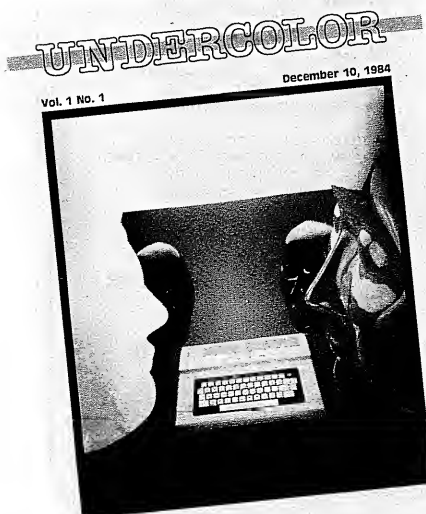
But what if you wanted to create a kind of super stopwatch? The Color Computer gives you a chance to do that, too. There isn't room to go into the details, but the horizontal synchronization from the video can also be used as an interrupt. This interrupt occurs 15,750 times each second, or once every 63.5 microseconds. This time, 63.5 microseconds is just over 56 computer clock cycles... hardly time to do much of anything. If you think 56 clock cycles isn't any time at all, though, turn to Steve Bjork's article on interrupts (Display Modes, December, 1983 TCCM); the pro speaks!

Figure 3 shows the schematic for interrupt handling in the Color Computer. Shown is the 6821 Peripheral Interface Adaptor (PIA). At the left the vertical (or field) synchronization is marked FS, and feeds CB1; horizontal synchronization is marked HS, and feeds CA1. By proper programming (refer to the 6821 data sheet for details), either can be fed through to the CPU's interrupt request pin via IRQA and IRQB (right side of the PIA).

Oh yes. Here's Rule Number 2: if you are using interrupts in an independent program that does not work with the Basic ROMs at all, be sure to reset the interrupt latch by reading the correct PIA location (LDA \$FF02). Otherwise, further interrupts won't be passed through the PIA, and you'll lose all the timing.

WHAT DOES IT ALL MEAN? I won't tie all this together until later in this series, but keep in mind that all these concepts involve timing — the ultra-fast timing of digital recording, the hidden timing of interrupts, and (in the next part) the slow timing of interfacing with external electronics.

Ed's Note: Articles referred to, except Part I of this series, are found in back issues of The Color Computer Magazine, unless otherwise noted.



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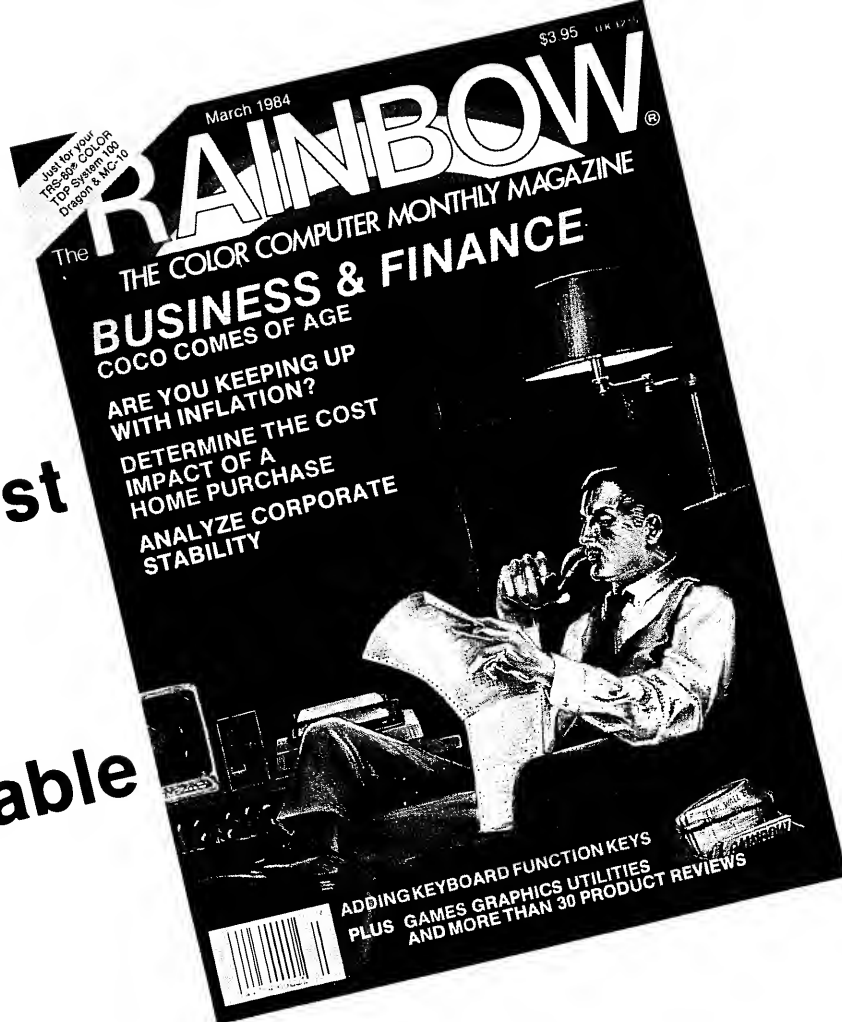
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Memory Test

By Stephen P. Allen

Memory prices the way they are now make it easy for a lot of people to upgrade their computer to a full 64K. It's a great feeling of satisfaction—"Aah, now I've got more power!"

"Wait a minute, how do I know I've *really* got 64K? Radio Shack says I've got to get a disk drive and OS-9 to use it. I don't really know if I even have it! I wish there was some way to test."

Is that you? Run this program.

RAMCHECK will give your computer memory a proper workout. If your memory chips extend all the way to 64K, you'll return from this program running Basic in RAM. And instead of ok, you'll see go as the prompt. If your RAMs flunk the test, RAMCHECK will tell you where your memory effectively ends.

The Program

The assembly language routine will alter the contents of all memory above 16K. The first job of the Basic program is to move the 6809's stack out of the way (leaving room for the routine). Don't change the addresses in Lines 30 and 40! If you move them higher there's the good chance the

routine or the stack will be over-written during the test.

After the necessary space is cleared, the routine is POKEd in and called with a USR function. The value of AR, returned by the assembly language subroutine, will be zero if you have 64K, or it will be the address where memory "ceased to exist." GIVABF, at \$B4F4, will treat any number given it that's larger than 32767 as negative. That's why 65536 is added if AR<0.

Switching between ROM and RAM is done by the 6883, that 40-pin mystery responsible for so much behind-the-scenes footwork. In all those 40 pins there are no data lines—the 6883 is controlled by simply writing to one of its 32 memory addresses. What's written doesn't matter; it can't read data, only addresses. The addresses that matter to us here are \$FFDE (select ROMs) and \$FFDF (select equivalent RAMs).

The byte values used to test the RAMs are \$55 and \$AA. In binary these correspond to 01010101 and 10101010. The values were chosen because these are the most difficult for memory to store—a one next to a zero may "influence" that zero to leak up to one, and vice-versa. I say *may* influence; I haven't seen it happen yet. (end)

Program Listing. RAM Check (Basic)

```
10 '      RAMCHECK
20 '
30 ' TESTS FOR 64K RAMS
40 ' IF YOU HAVE THEM YOU RETURN
50 ' IN ALL RAM MODE
60 ' ELSE END OF MEMORY IS
70 ' DISPLAYED
80 '
90 CLS:PRINTSTRING$(32,42)
100 PRINT@75,"RAMCHECKER
110 CLEAR200,12200
120 AD=12202:DEFUSR0=AD
130 READ OP:IFOP=1000 THEN150
140 POKEAD,OP:AD=AD+1:GOTO130
150 PRINT"CHECKING NOW...":HR=USR0(0)
160 IFHR=0THEN190ELSEIFHR<0THENHR=HR+65536
170 PRINT"RAM TEST FAILS AT $"HEX$(HR)
180 CLEAR200, HR-1:END
190 PRINT"NOW IN RAM!":CLEAR200,&H7FFF:END
200 DATA 142,63,255,26,80,183,255
210 DATA 223,134,85,167,132,161,132
220 DATA 38,44,72,104,132,161,132
230 DATA 38,37,48,1,140,255,0
240 DATA 37,234,142,128,0,183,255
250 DATA 222,166,132,183,255,223,167
260 DATA 128,140,240,0,37,241,134
270 DATA 71,198,79,253,171,238,79
280 DATA 95,126,180,244,183,255,222
290 DATA 31,16,126,180,244,1000
```

Program Listing. RAM Checker (Assembly Language)

```

00100 * RAMCHECKER
00110
00120 * Tests for 64K rams                                ERROR 003C
00130 * If you have them it copies                        LOOP1 0008
00140 * Basic to Ram and returns.                          LOOP2 0021
00150 * Else it tells where the Ram ends.                  START 0000
00160
00170
00180
0000 8E 3FFF 00190 START LDX    #$3FFF *Point to start of 32K
0003 1A 50 00200 ORCC    #$50  *Interrupts off
0005 B7 FFDF 00210 STA    $FFDF *Select "All Ram" mode
00212
0008 86 55 00220 LOOP1 LDA    #$55 *Binary 01010101
000A A7 84 00230 STA    ,X  *Store it
000C A1 84 00240 CMPA    ,X  *Did we get it back?
000E 26 2C 00250 BNE     ERROR *if not, this is end of Ram
0010 48 00 00260 ASLA                      *binary 10101010
0011 68 84 00270 ASL     ,X  *Same to Ram
0013 A1 84 00280 CMPA    ,X  *Did the Ram follow?
0015 26 25 00290 BNE     ERROR *if not, end of Ram
0017 30 01 00300 LEAX    1,X  *Test OK, move up one
0019 8C FF00 00310 CMPX    #$FF00 *Start of PIAs?
001C 25 EA 00320 BLO     LOOP1 *not yet-- keep going
00330
00332 * TEST SUCCESSFUL:
00340 * COPY BASIC TO RAM
00350
001E 8E 8000 00360 LDX    #$8000 *Start of Basic
0021 B7 FFDE 00370 LOOP2 STA    $FFDE *Select Roms
0024 A6 84 00380 LDA    ,X  *Grab a byte from Rom
0026 B7 FFDF 00390 STA    $FFDF *Select Ram mode
0029 A7 80 00400 STA    ,X+ *Duplicate byte in Ram
002B 8C F000 00410 CMPX    #$F000 *End of Roms?
002E 25 F1 00420 BLO     LOOP2 *Not yet
00430
00440 * CHANGE "OK" TO "GO"
00450
0030 86 47 00460 LDA    #'G
0032 C6 4F 00470 LDB    #'O
0034 FD ABEE 00480 STD    $ABEE *"OK" location
00490
00500 * GIVE A ZERO TO BASIC:
00510 * SHOW RAM TEST OK
00520
0037 4F 00530 CLRA
0038 5F 00540 CLRB
0039 7E B4F4 00550 JMP     $B4F4 *GIVABF
00560
00570 * ERROR: GIVE ERROR ADDRESS
00580 * BACK TO BASIC
00590
003C B7 FFDE 00600 ERROR STA    $FFDE *Select Rom mode
003F 1F 10 00610 TFR     X,D  *Last Ram address to D
0041 7E B4F4 00620 JMP     $B4F4 *and back to Basic's GIVABF
0000 0000 00630 END
00000 TOTAL ERRORS

```



Who's Fibonacci?

Author's Note: The following information is based on true fact, believe it or not. (Anyone know a false fact?)

Leonardo Fibonacci was an Italian mathematician who was a leading influence in mathematics during the Middle Ages. Scholars and generally polite people refer to him as Leonardo of Pisa. His neighbors in Pisa, however, called him *Bigollone* or "the Blockhead." His family name was of no help, either. His father's name, Bonaaccio, meant "Simpleton." Hence, Fibonacci was "Son of Simpleton."

He spent his formative years in the North African city of Bujaia, where his father was stationed as a customs official. Inquisitive young Leonardo was educated by the Muslims there, who taught him the Arabic numeral system. He quickly realized that working with this system was far simpler than the Roman numeral system in use in Europe; any half-intelligent school child knows that 1984 is easier to deal with than MCMLXXXIV!

After returning to Pisa as a young scholar, he spent several years contemplating this discovery. Leonardo was often seen wandering in a fog. When inspiration hit, he would grab a piece of chalk and absentmindedly scribble numbers on a nearby wall. At the age of 27, he published an historic manuscript, *Liber Abaci*, which introduced Arabic numerals to the European continent. This in itself was a major accomplishment, but one section of the book contained a theoretical problem that proved to be most interesting of all. The solution resulted in the discovery of the Fibonacci series.

The problem goes something like this: suppose someone placed a pair of rabbits in an enclosed area. If these rabbits were allowed to breed, how many pairs of rabbits would be born over the course of one year? Fibonacci figured that every month a pair of rabbits would be born, and that rabbits begin to bear young two months after their own birth. After this hare-raising experience, it was assumed that the original rabbits and their offspring would total 233 pairs. Fibonacci listed

the number of pairs at the end of each month: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233. When analyzing this group of numbers, he found that each number is the sum of the two preceding numbers. These numbers—1, 2, 3, 5, 8, 13 . . . —became known as the Fibonacci series. This series theoretically goes on forever, although you might end up with some thoroughly exhausted bunnies after awhile. By the way, there is no historical evidence that Fibonacci actually tried this experiment.

The series itself appears to be composed of seemingly random numbers, right? Well, any self-respecting Fibonacci scholar would tell you that each number has a special relationship to the numbers surrounding it. If you divide a number in the Fibonacci series by the next highest number, you will discover that the quotient is always about .6, or more precisely, .618034. This precise number works when the Fibonacci numbers are large enough to be precise (after about the 14th in the sequence). This number, .618034, is referred to as the Golden Mean. The ratio .618034 to one is the mathematical basis for eye-pleasing shapes in art, spiral galaxies, the curvature of a snail shell, and the shape of playing cards. Add to this the occurrence of Fibonacci numbers in botany and music, and you come up with some interesting patterns.

Plant life provides many examples of Fibonacci numbers. The number of pine needles that grow in a cluster on most species of pine trees tend to be 2, 3, or 5. Counting the number of petals on a daisy will most likely yield a Fibonacci number. Phyllotaxis, the arrangement of leaves on a stem, provide further evidence that these numbers are more than mere coin-

cidence. The number of leaves and turns on a stem are almost always Fibonacci numbers.

Musicians are aware that an octave is composed of eight notes. On a keyboard instrument, this is represented by eight white keys and five black keys for flats and sharps, for a total of 13.

Being the skeptic I am, I decided to check some of the number relationships. The pineapple's scaly outer skin is supposed to be made up of three distinct groups of logarithmic spirals; five go sharply in one direction, 13 in another, and finally eight in the third spiral. A trip to the local Valu-King proved this to be true. After checking about three pineapples in the produce department, I looked up and found myself staring at a plump Italian lady with an impatient expression on her face. I could have sworn she mumbled "Bigollone" as she snatched a pineapple and left.

Fort Worth, take note. The ratio of the Color Computer 2's length to width dimensions is .7106896, substantially closer to the Golden Mean than the first Color Computer, at .93220. The esthetically ideal Color Computer would have cabinet dimensions of $10\frac{1}{4} \times 16\frac{5}{8}$. ■

Bibliography for further reading:

Hoffer, William, "A Magic Ratio Recurs Throughout Nature," *Smithsonian*, December, 1975, pp. 110-124.

Hoggatt, Verner E., *Fibonacci and Lucas Numbers*, Boston: Houghton Mifflin Co., 1969.



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*** NEWS FROM UNDER COLOR *** NEWS FOR UNDER THE COLORS ***
***** Compiled November 26, 1984 *****
** Send news to: Under Color, Box 6809, Roxbury, VT 05669 **
***** CompuServe 70136,1257 *****

COCO GETS REDESIGNED AGAIN ... The Color Computer finally outstrips the venerable Model I in Tandy remakes. There are now NINE VERSIONS ... CoCol-C, D, E, NC; TDP-100; CoCo2, 2-A, 2-B; Korean CoCo2, KC2-B ... All the reworkings since NC are "economically driven designs", as one of the key engineers told U.C. ... Repairs to the new units? Forget it. SWAP the board.

* * * * *

SOCKETS VANISHED in the latest two Korean CoCos; in the first version, all but the SAM and the RAM are soldered in place. In the second version, even the SAM IS SOLDERED in, but more surprising are the RAMs -- just two sockets and two extra connectors. What's up? These are TWO 16K x 4 RAMs and -- get this -- a PIGGYBACK BOARD is needed to upgrade to 64K (does this sound like a 1980 deja-vu?) ... U.C.'s call to Forth Worth engineers revealed that the PIGLET REDESIGN WASN'T COMMON KNOWLEDGE there ... But wait! There's more. Read on...

* * * * *

\$199 64K COCOS continue to have eight 64K x 1 RAMs on board, but the 64K RAMs are SOLDERED IN PLACE! And, if that isn't enough to confuse users, reliable rumor (November 24) has it that Radio Shack's 26-3134B and 26-3136B computers are CoCos with LOWERCASE BUILT IN, and won't be released until AFTER THE HOLIDAYS. Using the 6847-T1 for a video display generator -- not Motorola's hot new RMS high-resolution chip set, as previously rumored -- the NEW COCO loses none of its previous features and compatibility, but doesn't gain in the high-resolution game. So when the warehouses are clear, LOOK FOR COCO REVISION #10 to hit the stores. Now, what about 256K MEMORIES, Tandy?

* * * * *

TECHNICAL DETAILS on the 16K Korean CoCo RAM setup: a 74LS785 version of the SAM, with TMS4416 RAMs, and Basic 1.3; two connectors and two sockets, with A0 through A7 from the SAM; D0 through D7 come from a new design enhancement, a 74LS623 octal bus transceiver from Texas Instruments (is Tandy moving away from Motorola?); CAS, RAS, R/W*; +5v and ground. MAKE YOUR OWN 64K upgrade? U.C. will give you the details as soon as we get them, but one of our SoCal hardware gurus tells us IT ISN'T THAT SIMPLE.

* * * * *

The MAGAZINE SHUFFLE at Ziff-Davis is still in the news. After cutting loose The Color Computer Magazine and other small computer rags, Z-D sold a boxful of titles for over \$100 million dollars ... that's NINE FIGURES. ... Meanwhile, on CompuServe's Color Special Interest Group (SIG), angry talk continues from subscribers who sent in the subscription in The Color Computer Magazine's last issue, and can't get a refund from Z-D. If you're a newcomer to CompuServe, GO PCS-126 and have a look around.

* * * * *

EVER WONDER WHAT IT COSTS to build one CoCo? How about 100 CoCos? U.C. did some shopping around for both retail and quantity pricing, and discovered some supprises ... THE DAYS OF BUILDING YOUR OWN MACHINE MAY BE OVER. Below are some retail and 100-piece quantities for Radio Shack's \$199 64K Extended Basic Color Computer:

Item	Single	100's	Item	Single	100's
CPU	\$ 9.95	\$ 8.10	SAM	\$25.00	\$18.67
PIA (2)	9.00	3.60	64K RAMs	39.95	24.80
VDG	12.95	11.00	74LS273	1.80	.73
74LS244	1.80	.73	74LS02	.42	.21
74LS138	.80	.54	2 ROMs (N/A; see next item)		
555	.42	.18	2 EPROMs	30.00	8.60
crystal	4.95	1.80	switches	3.93	1.50
4 jacks	3.96	1.80	8 sockets	2.32	1.42
2 special chips (based on similar parts)		5.50			1.00
47 capacitors (mixed, best prices)		14.69			4.43
13 diodes, 3 transistors		7.91			1.76
33 resistors, 2 inductors		4.43			.49
power transformer, cassette relay		7.90			5.50
video modulator, TV switch box, cable		13.90			4.80
cartridge connector, AC line cord		5.90			2.43
printed circuit board (quote)		(by hand)			22.00
keyboard		39.95			18.00
Basic programming books		(none)			8.00

THE TOTAL, NOT INCLUDING PHONE CALLS,
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BUY one complete CoCo at \$199 and SAVE \$48.43 over a hand-wired, caseless CoCo. BUILD 100 caseless CoCos for \$15,209 save \$4,691 over buying them (but who will PAY THE LICENSE FEE FOR COLOR BASIC?). How much DOES RADIO SHACK PAY for parts in 10,000 quantity to make a PROFIT AT \$199?

* * * * *

*** NEWS FROM UNDER COLOR *** NEWS FOR UNDER THE COLORS ***
***** Compiled November 26, 1984 *****
** Send news to: Under Color, Box 6809, Roxbury, VT 05669 **
***** CompuServe 70136,1257 *****

A NEW COLOR BBS in Monterey, California, is on line, and SysOp Marc Rigas wants everyone to call, since he says "I need a LOT OF CALLERS if I am to keep it running." Sounds like a CHALLENGE. Weekdays 6-8pm, 10pm-7am; Saturday 12-4pm; Sunday 10pm-7am. Call (408) 646-1850 and help Marc keep his BBS running.

* * * * *

An NTSC COLOR COMPUTER is available by special order from Radio Shack ... for you COLOR VIDEO MONITOR users. Reports from the first few purchasers offer mixed reactions to the quality of the signal; U.C. will provide comparatives soon. In the meantime, Radio Shack will NOT RETROFIT existing CoCos with the monitor modification.

* * * * *

SOFTWARE PROTECTION (AGAIN) ... Controversy has been raging around DELIBERATE SECTOR DAMAGE BY LASER BEAM used for PROTECTION of disk software. A few suppliers have been using the protection scheme, which introduces a deliberate pit in one specific location of the disk's oxide coating -- making it UNWRITABLE. The software tries to write information to that special sector ... it assumes the diskette is an original ONLY IF IT GETS AN ERROR. If not -- WHAMMO! It either bombs out (the nice version) or else it ERASES EVERYTHING IT CAN FIND ON THE DISK. Some distributors have RETREATED from this scheme, others defend it. Apparently no DISK HEAD DAMAGE will occur, since the laser pit system is carefully designed to resemble a normal, microscopic disk blemish.

* * * * *

HARDWARE PROTECTION is going on, too. A video digitizer is being released before the holidays with ALL THE ELECTRONICS POTTED IN EPOXY and NO SCHEMATIC provided. Apparently the item is LOW COST and the manufacturer is worried about gnomes running off to some HI-TECH SWEATSHOP and copying it. Repairs? Modifications? Better ask before you buy. With the small-computer SHAKEOUT underway now, you can't tell who will still be here NEXT CHRISTMAS.

* * * * *

OVERHEARD on the Color SIG: "Meanwhile back at primeval swamp where the original CoCo still lurks, it is seen as slowly succumbing to a sickly diet of arcade games -- seen as a computer with no redeeming social value."

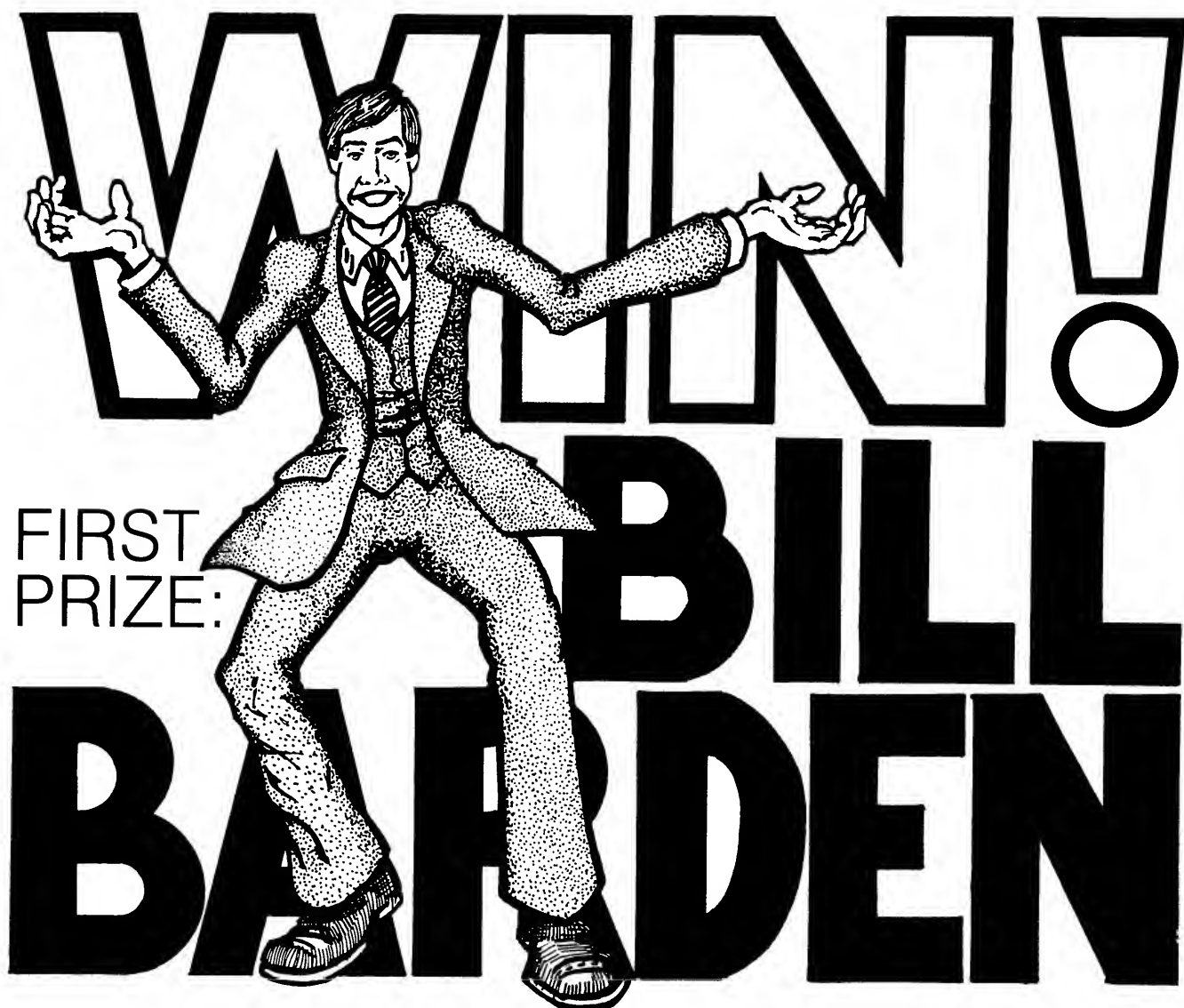
* * * * *

COLOR BASIC 1.3 IS HERE ... but don't worry. It's only change is to accommodate the UPGRADED SAM in the new Korean CoCo. Everything else is (for a change) ENTIRELY COMPATIBLE with the Color Basic 1.2 that's been standard for about a year.

* * * * *

For future reference.....

26-3001	4K Color Computer, Color Basic, grey case
26-3002	16K Color Computer, Extended Basic, grey case
26-3003	32K Color Computer, Extended Basic, grey case
26-3003A	64K Color Computer, Extended Basic, white case
26-3004	16K Color Computer, Color Basic, grey case
26-3004A	16K Color Computer, Color Basic, white case
26-3005	??
26-3006	Color Computer Dust Cover
26-3007	Color Computer Carrying Case
26-3008	Joysticks, original version
26-3009	4-pin to 5-pin cable
26-3010	13" Color TV Receiver
26-3011	4K MC-10 Micro Color Computer
26-3012	Deluxe Joysticks
26-3013	16K RAM cartridge for MC-10 Computer
26-3014	4-pin DIN to 25-pin DB-25 serial connector
26-3015	16K RAM kit for original Color Computer
26-3016	New Keyboard Upgrade, keyboard version #2
26-3017	64K RAM kit for Color Computer 1 & 2
26-3018	Extended Basic ROM kit
26-3019	Diagnostic ROM cartridge for Color 1
26-3020	4-pin DIN to 4-pin DIN cable
26-3021	??
26-3022	Color Disk #0, 5/12-volt version
26-3023	Color Disk #1, 2, 3
26-3024	Multi-Pak Interface
26-3025	Color Mouse
26-3026	16K Color Computer 2, Color Basic
26-3027	16K Color Computer 2, Extended Basic
26-3028	??
26-3029	Color Disk Drive #0, 5-volt version
26-3030	OS-9 with EDTASM+ Disk Version
26-3036	BASIC-09 Disk Version
26-3134	16K Color Computer 2, new keyboard
26-3136	16K Color Computer 2, Extended, new keyboard
26-3137	64K Color Computer 2, Extended, new keyboard
26-3134A	16K "Korean" 16K Color Computer 2
26-3136A	16K "Korean" 16K Color 2, Extended
26-5000	4K Videotex Terminal
26-5001	16K Videotex Terminal



By Bill Barden

RULES:

Ready to win *Big Money*? Do you like fame and notoriety? Would you like to be feted and dined in every major Color Computer center from Appleton, Maine to Mission Viejo, California? If this appeals to you, enter the First Great International *UnderColor* Magazine Programming and Pie Eating Contest!

In all seriousness, readers, this contest does give you a chance to win a prize. The grand prize consists of two hours of free advice from Bill Barden. If you win the contest, Bill will give you a call at a mutually agreed upon time to discuss your hopes, dreams, and aspirations regarding your pet Color Computer project—anything from graphics to assembly language. You can use this consulting time in any way you'd like, ask any questions you'd like, or even get tutorial advice. It's Bill's nickel on the phone charges, too!

Runnerups will be listed in the pages of *Under Color*.

Ready for the contest question? You don't have to be a super programmer to answer it—all it takes is a little research, a little hard work, and some originality. Here it is:

Write an Extended Basic program that draws a spiral figure on graphics screen 0 on PMode 4 (256 × 192 resolution). The figure, when done, should look like Figure 1. That's it! You can use any combination of Basic commands you'd like, but no assembly language please. The winner will be the reader whose program executes in the shortest possible time. (Entries that simply list a series of Line commands will be disqualified.) When you've finished the program, send a listing and either a cassette tape or disk file to: William Barden, Jr., P.O. Box 3568, Mission Viejo, CA 92692.

Along with your entry also indicate the approximate time the program takes to execute, and be sure to say it's an *Under Color* contest entry!

THE SPIRAL:

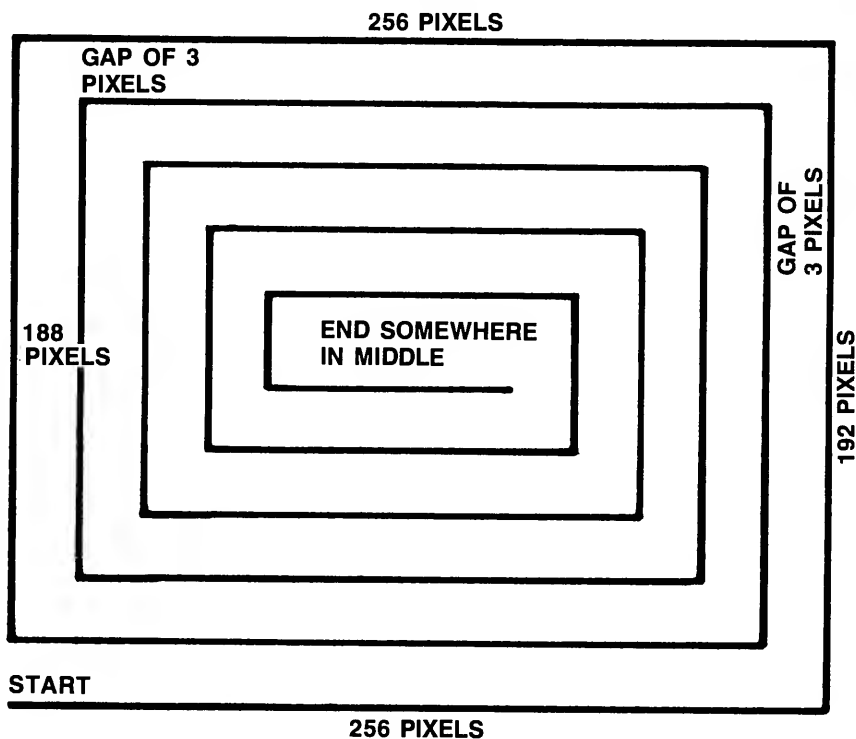


Figure 1. The Spiral

NOTES:

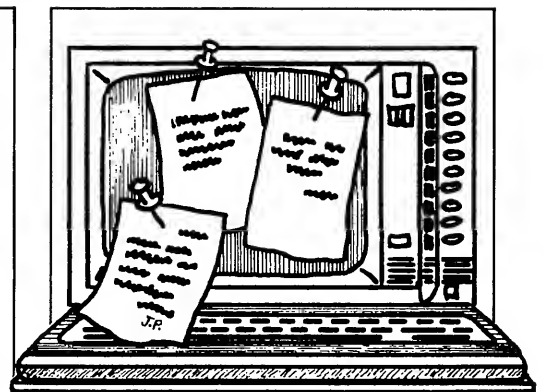
1. LINES MUST BE SEPARATED BY 3 PIXELS.
2. THIS FIGURE NOT ACCURATE AS FAR AS TOTAL NUMBER OF LINES.

JUDGING:

Bill will judge the entries on these criteria: he will first look at the approximate times for execution, and discard those entries that are obviously too slow. He will then test the remaining entries to see that they produce the figure, measure the execution time, and select a winner. The winner will then be notified via *Under Color*.

CLOSING DATES:

The closing date for entries is January 15, 1985. The winner and runners-up will be announced early in 1985. Good luck!



Bulletin Boards

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The Evansville Connection is on-line Saturdays and Sundays from 9 a.m.-9 p.m. Email, download, graphics, news: call 812-476-9453.

Tracy, CA

The Tracy BBS is available 24 hours a day: call 209-835-6496.

Joplin, MO

David Morgan is Sysop, 7 a.m.-12:30 a.m. Call 417-781-4020.

Yonkers, NY

Colorama is available 24 hours. Up-and down-load, want ads, boutique; Fred Siudym, Sysop. Call 914-965-7600.

Salem, OR

Les Taylor, Sysop; 300 baud, public access. Call 503-362-1351.

Reston, VA

Samohr is available Saturday and Sunday 6 a.m.-10 a.m.; M-F 6 p.m.-7 p.m. Mail, newsletters, downloads. Call 703-476-1147.

Camarillo, CA

Communicom-80: Beginners, D&D players. Call 805-484-5040.

Crawford, NE

Colorama; Rick Hungerford, Sysop. Available M-F 5 p.m.-8 a.m.; Saturday and Sunday 24 hours. Call 308-665-1526.

Long Beach, CA

Fineboard; Kenneth Fine, Sysop. Available Wednesdays 5 p.m.-12 a.m. Call 213-424-1803.

Port Mouton, Nova Scotia

Colorama; Jeff Pyne, Sysop. Available 24 hours; up- and down-loads, messages, on-line games. Call 902-683-7086.

The TRS-80's User's Encyclopedia
(Color Computer and MC-10)
by Gary Phillips and Guier Wright III
The Book Company
11223 South Hindry Avenue
Los Angeles, CA 90045
241 pages
\$14.95—8½" x 11" paperback

By Terry Kepner

At first glance I had high hopes for this book; unfortunately, it let me down. The name proclaims it's an *encyclopedia*: as such a combination computer dictionary, software/hardware directory, user group listing, and general purpose resource. It covers practically everything about the Color Computer and MC-10, including their respective Basic commands (with plain English descriptions and examples). And all is organized in alphabetical order. So, how could it let me down?

Trying to review a book like this is difficult; there isn't much to say about the entries, except to note their completeness and accuracy. And with so many entries, it's easier to point out errors than to praise good aspects. I've got to say that I'm unaware of so complete a listing of software and hardware suppliers and their products available anywhere else. The same can be said of the User Group listings. And the dictionary entries are tailored to the Color Computer market, leaving out many terms that have nothing to do with TRS-80 computers.

The disadvantage that cripples this book is that it is very poorly cross-referenced. For example, page 129 lists five magazines that might be of interest to Color Computer owners; it doesn't list *Color Computer News* and gives the wrong name for *Hot CoCo* (calling it "Hot Color Computer" instead). If you look under the heading "Color Computer" (page 44), you find *Color Computer News* listed, but not the *Color Computer Magazine* (listed on page 129).

Another cross-reference error is under the headings about the Forth language: under the entry "Forth," only Frank Hoqq Labs is mentioned; but under "Programming Languages" four of the five Forths are listed; and all five are listed under their individual names (scattered throughout the book in alphabetical order).

Some entries are mysteriously left out; for example, the two hardware products that convert Color Computer serial printer output to parallel printer output are listed, but a description of parallel printers isn't included. And under the entry "Printers" is a list of about a dozen, but by no means is it a complete list of the printers mentioned in the book.

In spite of this, the *Encyclopedia* is a useful reference book that covers a wide field. Careful thought by the user will guide you to most areas in the book where you might find the information you desire. And if you're looking for programs, this is a source worth having.

If the book were adequately cross-referenced, it would be a "must have" item. As it is, I must rate the book as interesting, well worth buying if you have a problem it can solve (such as trying to locate software, user groups, or manufacturers). You should bear in mind as with any reference of this type, many

areas are already outdated; any product, user group, and/or manufacturer making an appearance after approximately January 1984 couldn't be listed in this particular reference encyclopedia. (end)

Grobot

Children's Computer Workshop
Tandy/Radio Shack Corporation
Fort Worth, Texas 76102
Extended Basic, Joysticks,
Cassette Recorder Req. \$19.95.

By Dennis Peterson

If you remember, The Children's Computer Workshop budded from Children's Television Workshop, the creators of *Sesame Street*. Grobot, designed for players ten years or older, is a relatively recent bloom from CCW's garden of good ideas. For this age group the manufacturer has its games stress "creative exploration." This is true for Grobot. You should understand that the first purpose of the software is to be a game—it isn't an educational program in a game format.

Most children's software manufacturers soft-peddle the violence aspect of computer games. This holds true in Grobot, keeping close to what appears to be the philosophy of CCW. Even what is commonly referred to as the Joystick's "fire" button is referred to as the "red action button" in the very clearly written user's manual.

Play the game: you are a gardener on the strange and wonderful Planet Kaldas, on which 16 plants, with names like Kalidobean, Gaboink and Shishkabud, can live. These plants grow best in certain climates, and coincidentally there just happen to be four distinct climates on Kaldas. In the Kaldasian Farmer's Almanac, located near the end of the user's manual, you'll find the point value for each Plant, a value which varies with the climatic area in which it is grown. For example, a harvested Arroid is worth only 25 points in a hot and dry climate, but its value climbs to a whopping 800 points harvested in a cold and wet climate, where is it more difficult to grow. A few pieces of information are missing in the Almanac for some plants, giving the player a chance to discover some facts on his own.

As gardner, using the information from the Almanac and a weather forecast, you determine which plants to grow and determine strategy to harvest the maximum number of points. To help with your gardening, you control an energetic little gardening robot, called (of course) Grobot, who rides around in a flying-saucerish harvesting, picking plants as they bloom on your command. This isn't as easy as it sounds; the garden, like any real garden, is afflicted by pests. These are the voracious, fast-flying, flower-eating Astro-Gnats, and the slithering, root-munching Verms. In keeping with the non-violence theme, Grobot can be used to scare these Pests from the screen, rather than spray or swat them. You and Grobot will have some very busy moments.

Grobot should capture the interest of most family members, not only because of the actual game play, but because of the pre-play planning. It might be the most refreshing investment in your video game library. (end)

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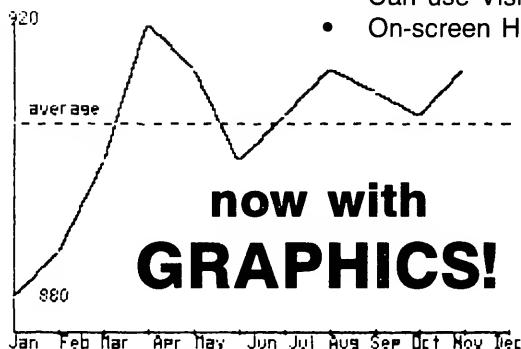
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